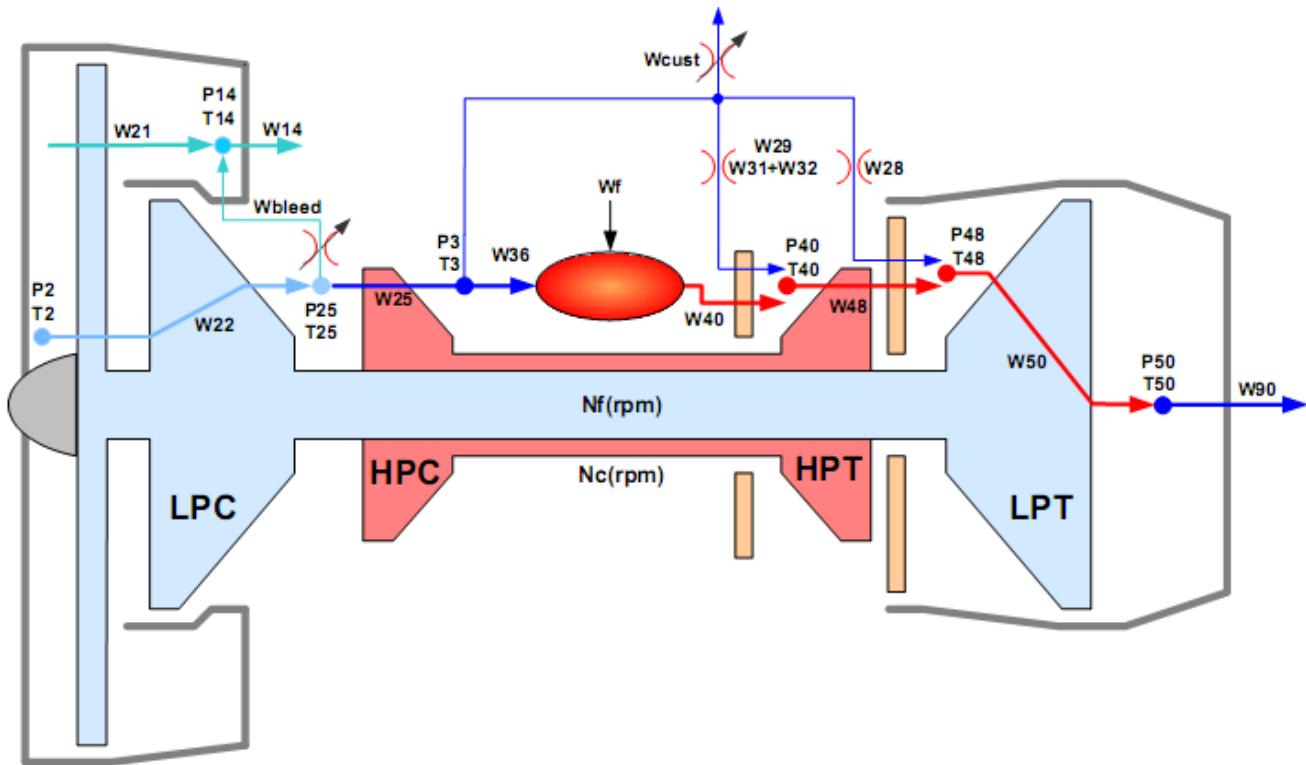


# C-MAPSS40k Demonstration

## Ryan May and Jeffrey Csank





# Overview

- C-MAPSS40k in Brief
- Interface Options
  - GUI
  - From Files
  - From MATLAB Command Line
- Viewing Outputs
- Demonstration



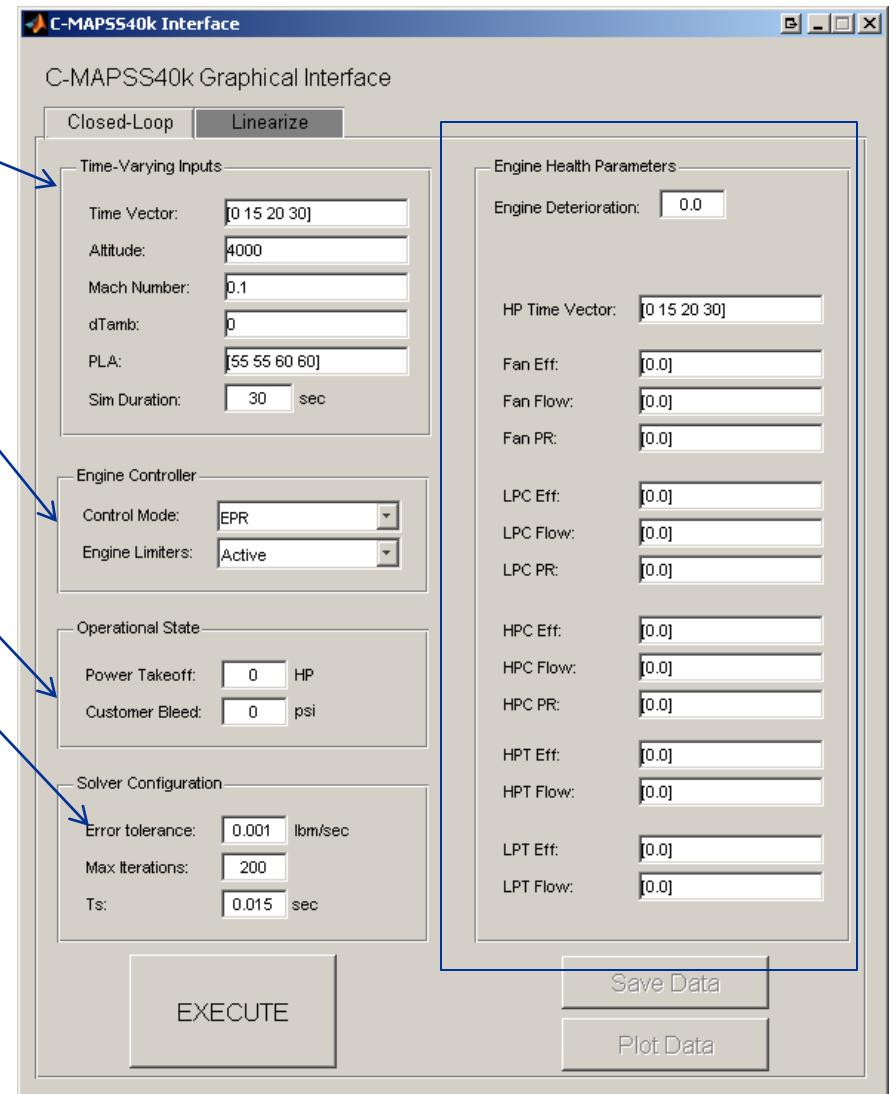
# What is C-MAPSS40k

- 40,000 Lb Thrust Class, High Bypass, Turbofan Jet Engine Simulation
- MATLAB / Simulink Environment
- Realistic Controller which meets FAA Regulations
- Stall Margin Calculation
- Steady State Solver
- Linearization Function
- Faults
- Deterioration



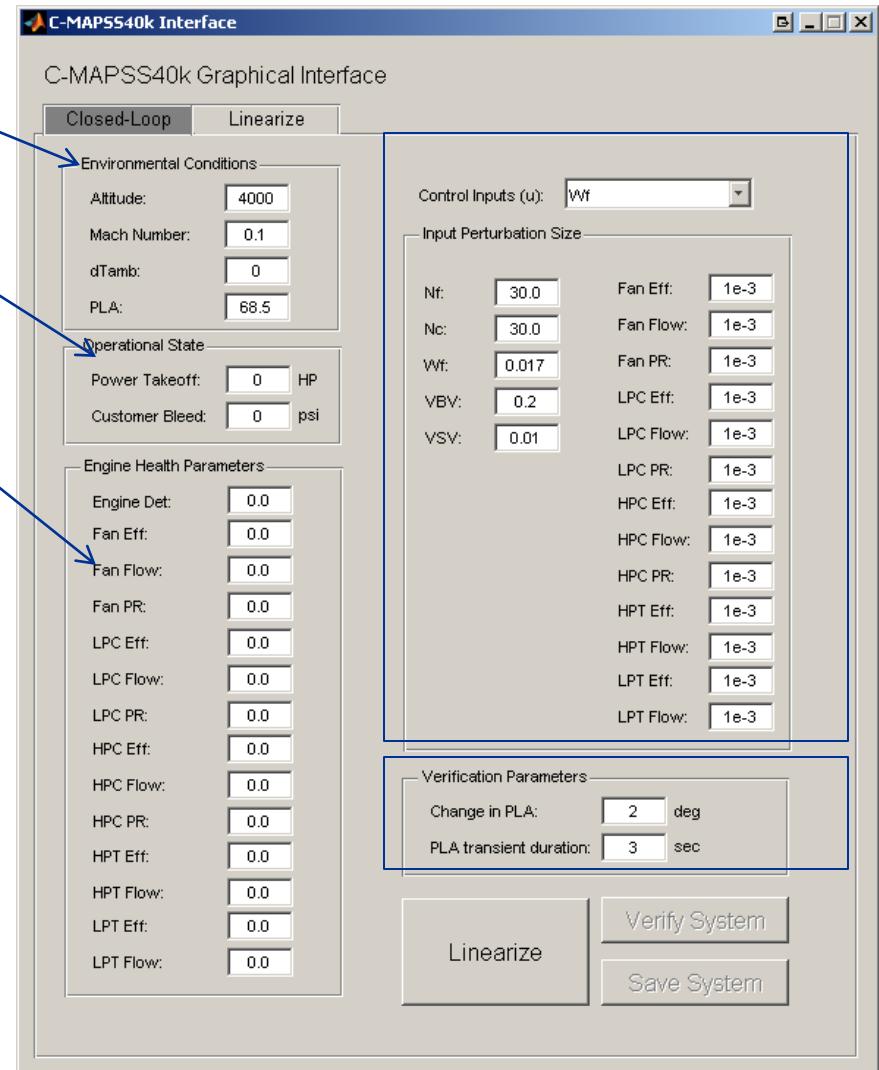
# Closed Loop GUI Operation

- Flight Conditions
- Controller Types
  - Fan Speed
  - Engine Pressure Ratio
- Operational State
- Solver Configuration
- Health Parameters
- Run Simulation
- Save Data (.mat)
- Plot Data (.fig)



# Linearization GUI Operation

- Flight Condition
  - Operation State
  - Engine Health Parameters
  - Linearization Commands
  - Verification Parameters
- 
- Linearize
  - Verify System
  - Save System





# From File Operation

- Closed Loop Operation
  - Open and edit define\_inputs.m
  - Command Line Command
    - >> setup\_everything.m
  - Run PAX200.mdl file
- Linearization
  - Open and edit linearize\_CMAPSS40k.m
    - Also contains verification commands
  - Command Line Command
    - >> setup\_everything
    - >> linearize\_CMAPSS40k.m



# From MATLAB Command Line/M-Code

- Can define input parameters to base workspace by prefixing the variable name with “in\_”
- Run “setup\_everything”
- Use the MATLAB sim command to execute the simulation

```
in_t_vec = [0 15 15.015 30];
in_alt = 20000;
in_MN = 0.5;
in_dTamb = 10;
in_PLA = [50 50 75 75];

tFinal = 60; %duration of simulation

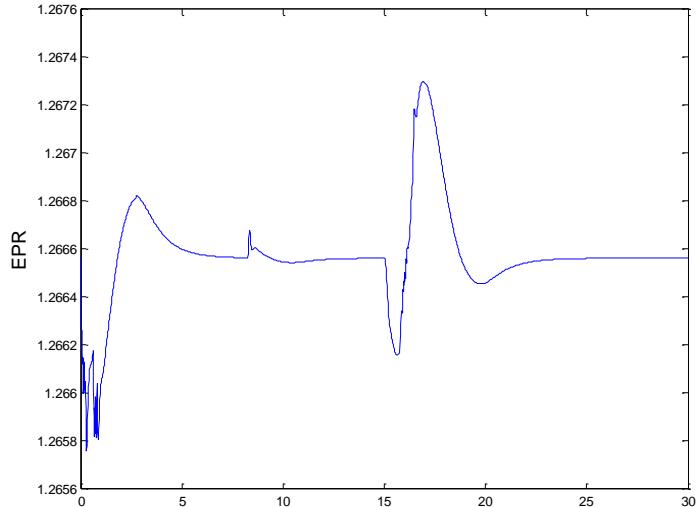
if(isInCMAPSS40kEnvelope(in_alt,in_MN))
    setup_everything;
    sim('pax200',tFinal);
    cleanup_CMAPSS40k;
end
```



# Viewing Outputs

- Outputs are all labeled “out\_”
- View data on Simulink “Scopes”
- Can use GUI to plot
  - Press Plot Data button
  - edit the “gui\_plotter.m” file to change the plots
- Can manipulate data via MATLAB Command Line

```
plot(out_t,out_P50./out_P2)
ylabel('EPR')
```





# Demo

- Use both the GUI and File Editing approach for the following Simulations
  - Normal Operation
  - Linearization
  - Deteriorated Engine
  - Fault
- Example of iterative testing using M-Code